

August 8, 2003

MEMORANDUM FOR: Kendall L. Fancher
Project Director

FROM: Charles W. Challstrom
Director, National Geodetic Survey

SUBJECT: INSTRUCTIONS: LOUISIANA EVACUATION ROUTE
SURVEY - HIGHWAY 61 (AIRLINE HIGHWAY)
(GPS-1897) Task Number: A8K6DHDP00

GENERAL:

As part of the "St. Charles Parish Water Level Monitoring System," the Center for Operational Oceanographic Products and Services (CO-OPS) recently established two new real-time National Water Level Observation Network (NWLON) stations at Bayou Gauche, Lake Ponchartrain, and at Bayou LaBranche, Lake Salvador. CO-OPS requested that NGS conduct a GPS survey to provide up-to-date, accurate heights on a ten-mile portion of Highway 61 (Airline Highway) and on two new NWLON stations as soon as possible in order to utilize the new real-time water level information to predict flooding of the Highway during the current hurricane season. By surveying the floodprone portion of Highway 61 near the NWLON stations, the water level data from these stations will enable the Parish and emergency managers to accurately monitor, predict, and plan for the potential flooding of this heavily traveled route.

The National Geodetic Survey (NGS), in accordance with the National Height Modernization Initiative, will advise and assist the Louisiana Spatial Reference Center (LSRC) and other participants in their effort to determine heights along hurricane evacuation routes in southern Louisiana. These heights will be critical in predicting inundation from storm surge.

Some additional benefits associated with the National Height Modernization Initiative are:

- * Replace labor-intensive, high-cost leveling procedures with new cost-efficient GPS technology
- * Decrease survey costs associated with flood plain and other mapping and GIS activities

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* Provide more accurate modeling for storm surge prediction

* Improve disaster preparedness.

Mr. Robert Zurfluh, Louisiana State Advisor, will perform the necessary reconnaissance.

PURPOSE:

NGS will provide a team of Height Modernization Specialists to provide coordination, assistance, and technical advice to determine accurate heights along the hurricane evacuation route - Highway 61 (Airline Highway). The road elevations will be tied to the nearby NWLON water level station bench marks. NGS has previously performed two surveys on coastal evacuation routes and is currently in the process of developing, documenting, and validating the kinematic GPS survey techniques for road way surveys. Once completed, the road survey guidelines using kinematic GPS will be available for outside users wishing to perform these types of surveys to NGS standards. Additionally, a real-time kinematic survey will be performed during the Highway 61 survey and compared with the (post-processed) kinematic GPS survey for further research on real-time GPS applications. The elevations of the Highway will be provided in NAVD 88 and tied to bench marks at the two NWLON stations and to control in the VTDP model developed by the LSRC. Static GPS observations will be used to validate the VTDP model.

SPECIFICATIONS:

Project requirements for the observations are as follows:

* Ensure 5 cm ellipsoid height local accuracy

* Establish at least four “control stations” (two along the Highway, two at the water level gauge) along Louisiana Highway 61 using existing bench mark or horizontal control points. The control stations at the water level gauges will be observed with four 8-hour sessions at 15 second epochs at 10 degree elevation mask. The “control stations” along the kinematic survey route will collect data at an epoch rate of 1 second during the continuous kinematic survey and at an epoch rate of 5 seconds during the stop and go kinematic survey.

* Use existing benchmarks or set PK nails at regular intervals and at high points and low points along the road to determine their positions and elevations using GPS “stop and go kinematic” methods to serve as height validation points. Each validation point will be statically observed at least twice with an occupation separation of at least 45 minutes for a minimum of 5 minutes for each occupation at epoch rate of 5 seconds and 10 degree elevation mask.

* Perform continuous kinematic GPS survey along Louisiana Highway 61, for determining the road profile, observing at 1 second epoch rate and 10 degree elevation mask. The kinematic survey will be divided into a number of segments between two control points with an overlap of at least 1/10th of a mile. There will be a file for each segment with a naming convention of: starting control station ID and the ending control station ID, abbreviation of direction traveled, and the lane traveled.

Example K367SSL.XXX--Starting Station is K 367, traveling South, in the Slow Lane.

The Validation Points and highway profile data, determined by Stop & Go and Continuous Kinematic methods will be redetermined using RTK GPS techniques before departing the project.

Perform RTK GPS survey along Highway 61. The results of the RTK will be checked by Kinematic survey.

Data from the CORS in the region are to be used in the processing. There are 8 National CORS in the area with six in Louisiana and two in Mississippi.

The six CORS in Louisiana are Winnfield (WNFL), Hammond (HAMM), Boothville (BVHS), Cocodrie (LUMC), English Turn (ENG1), and Lafayette (KJUN). The two CORS in Mississippi are Stennis (NDBC) and Vicksburg (VIC1).

CORS data are available from the NGS web site.

In general, station occupation and observing procedures must be carried out according to appropriate sections of the "NGS Operations Handbook" and the current applicable receiver field manuals. Data formats and digital file definitions are given in "Input Formats and Specifications of the National Geodetic Survey Data Base," Volume I. Horizontal Control Data, Federal Geodetic Control Subcommittee, September 1994, revised and reprinted November 1998. Success in meeting the accuracy standards will be based on repeatability of measurements and adjustment residuals.

General specifications for the project are given in "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques," Version 5.0: dated May 11, 1988, reprinted with corrections August 1, 1989. Specific project criteria and deviations from the general specifications are given in the following sections.

Data Acquisition - Data collection must be accomplished as specified in the appropriate dual-frequency receiver field manuals in the compressed mode. The GPS receivers must be dual-frequency and full-wavelength.

Record weather data just before, immediately after, and at the mid-point of each session. Meteorological data shall also be collected immediately after an obvious weather front passes during a

session and immediately before it passes, if possible. Pressure and relative humidity measurements must be made near and at about the height of the GPS antenna phase center. Indicate in the log the location of the barometer and psychrometer.

Survey operations shall be conducted with due regard to the safety of personnel and equipment. Contact with the airport traffic control tower is mandatory during surveys at any controlled airports.

Vector Computations - Data management, quality review of collected data, and final vector processing for the static observations will be accomplished using PAGES. Vectors shall be computed in the International Earth Rotation Service Terrestrial Reference Frame (ITRF) system, using the most current epoch and precise IGS ephemerides. Use 30-second epoch intervals for data processing. Monument positions will be used for CORS when available, otherwise, antenna reference point (ARP) positions will be used. Mr. Fancher, N/NGS11, will be responsible for the processing.

GPS “stop and go kinematic” data will be processed using Ashtech’s Solutions software. An averaged OPUS solution, from a minimum of 3 eight hour sessions per control station, will be used for fixed control during processing.

Ashtech Solutions software will be used to field check the Continuous Kinematic data. An averaged OPUS solution, from a minimum of 3 eight hour sessions per control station, will be used for fixed control during processing. Processing of this data will also be conducted using GrafNav Software. Results of the kinematic survey will be given to N/NGS3 for generation of a Digital Elevation Model.

The project data will be processed in 24-hour sessions (or slightly longer if the observation session crosses 0000 UTC) in order to utilize the 24-hour data sets collected at the CORS.

The “fixed baseline” option in PAGES will be used to compute direct baselines between the CORS. The “fixed baseline” scheme will depend on the location and reliability of the CORS used in this project.

For stations where weather data are not available, or are suspect, predicted values will be computed and used based on the station's latitude, height above mean sea level, and time and day of year. Use 15 degrees as the cutoff elevation angle in data processing. A cutoff angle of 10 degrees may be used when necessary to improve results.

The type of final solution, L1 versus ion-free, will depend on the length of the vectors. For vectors which are less than 10 km in length, the final reduction will consist of a L1 fixed solution. These vectors will be computed in a separate processing session from the longer vectors computed in an ion-free solution.

In general, vectors greater than 10 km in length are to be computed in an ion-free fixed, or partially-fixed, solution. In all cases, integer ambiguities will be fixed for each vector whenever possible. The quality of collected data shall be determined from the plots generated from

PAGES, by analysis of repeated vectors and/or comparison of station positions, and free adjustment residuals and/or loop misclosures. In addition, a constrained adjustment constraining all CORS will be performed.

Mr. Fancher, N/NGS11, will perform all quality checks for conformance with NGS format standards such as executing software programs COMPGb, OBSCHK, and OBSDES. The final ITRF vectors will be assessed and transformed to the NAD 83 coordinate system using program ADJUST.

The data and results will be submitted to the Observation and Analysis Division. All B-files and G-files must be complete, including *25* and *27* records.

Profile Data - Personnel from the N/NGS11 will perform the processing of the Continuous Kinematic Survey data. The Validation Points, determined by Stop & Go kinematic methods will be used for quality control.

Station Descriptions - Station recovery notes must be submitted in computer-readable form using WDDPROC software. Include the name, address, and, if public ownership, the telephone number of the responsible party. Do not include the telephone numbers of private property owners. Mr. Zurfluh will be responsible for the descriptions.

Special Requirements - Antenna set-up is critical to the success of this project. Fixed-height tripods are preferred for all receivers. Fixed-height tripods shall be tested for stability, plumb alignment, and height verification at the start and end of the project. The plumbing bubbles on the antenna pole of the fixed-height tripod must be shaded when plumbing is performed. They must be shaded for at least 3 minutes before checking and/or re-plumbing. Also, the perpendicularity of the poles must be checked at the beginning of the project and any other time there is suspicion of a problem.

When a fixed-height tripod is not used, the height of the antenna must be carefully measured to prevent station set-up blunders from occurring. Tribrachs used for these set-ups must be checked and adjusted when necessary. Totally independent measurements of the antenna height above the mark in both metric and English units must be made before and after each session. Someone other than the observer must check the measurement computations by carefully comparing measurements and then entering his/her initials on the log. Some GPS antennas have detachable ground planes and radomes. In order to help identify what exactly was used at a particular site, it would be useful to have a snapshot of the setup. All observers should take a photograph of the setup, if possible, with a close-up of the antenna as viewed from the side.

In addition, digital photographs of each survey mark are required. See "Requirements for Digital Photographs of Survey Control," Version 10, for specific information.

Also, a rubbing of the stamping of the mark must be made at each visit to a station. If it is impossible to make a rubbing of the mark, a plan sketch of the mark must be substituted, accurately recording all markings.

Also, for each station visited, a visibility obstruction diagram must be prepared and the TO-REACH description carefully checked for errors or omissions.

Lastly, the following must be recorded on the GPS Station Observation Log form (available at <http://www.ngs.noaa.gov/PROJECTS/FBN> and click on the Forms link) at each occupation of a station:

- (1) receiver manufacturer,
- (2) antenna manufacturer,
- (3) receiver model number (part number),
- (4) antenna model number (part number),
- (5) the complete serial number of the receiver, and
- (6) the complete serial number of the antenna.

Success of this project requires that the highest quality GPS data be collected. Therefore, during each station occupation, the operators shall carefully monitor the operation of the receivers. Any irregularities in the data due to equipment malfunction, DOD adjustment of the satellite orbit, obstructions, etc., must be reported to the Project Development Branch, N/NGS21, as soon as possible and noted on the observing log. If the quality of observations for an observing session is questionable, notify the Project Development Branch immediately.

The survey team shall not depart the project area until they have quality reviewed all data and advised N/NGS21.

GPS DATA:

Visibility tables and plots of the present satellite constellation have been reviewed and an observing window selected. Observations are to begin at 1300 UTC. For operational use, current data must be generated with Ashtech mission planning software or from program SATMAP.

A project report and data listed in Annex L of "Input Formats and Specifications of the NGS Data Base" and in the attached addendum (for the adjustment portion of the project) must be transmitted.

Any data considered suspect as to quality in achieving accuracy standards should be sent via FedEx immediately for office review. Backup of transmitted data must be held until notified by the Project Development Branch, N/NGS21.

The data set collected during the project shall be named "lanv063d.1177". All records in connection with this project shall be titled "LOUISIANA EVACUATION ROUTE SURVEY - HIGHWAY 61 (AIRLINE HIGHWAY)." The project number (accession number) is GPS-1897.

LIAISON:

Liaison must be maintained with designated offices at the National Geodetic Survey headquarters located at:

1315 East-West Highway
Silver Spring, Maryland 20910-3282

Questions and problems concerning survey field operations should be directed to:

Stephen J. Frakes
Chief, Project Development Branch
Spatial Reference System Division
N/NGS21, SSMC III, Station 8853
Telephone: 301-713-3194, ext. 111
Fax: 301-713-4316
e-Mail: Steve.Frakes@noaa.gov

Questions and problems concerning processing should be directed to:

Kendall Fancher
N/NGS11
Corbin, VA 22446-0190
Telephone: 540-373-1243
E-Mail: Kendall.Fancher@noaa.gov

Questions and problems concerning using CORS data in processing should be directed to:

Miranda Chin
Geosciences Research Division
N/NGS6, SSMC III, Station 9844

Telephone: 301-713-2844, ext. 125
Fax: 301-713-4475
e-Mail: Miranda.Chin@noaa.gov

Questions and problems which could affect the technical adequacy of the project should be directed to:

Stephen J. Frakes
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The NGS project coordinator is:

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The contacts for the project are:

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Fax: 225-219-0513
e-Mail: Robert.Zurfluh@noaa.gov

Tim Osborn
National Ocean Service
Telephone: 337-291-2111
e-Mail: Tim.Osborn@noaa.gov

Names and telephone numbers of local contacts are given in the station description material.

ADDRESS:

Keep N/NGS21 informed of the party's post office, physical address, and telephone number at all times.

PUBLICITY:

See "NGS Operations Handbook," Section 1.4.1.

EXPENSES:

Expenses for this project will be charged to task number A8K6DHDP00.

TRAVEL:

Travel and per diem are authorized in accordance with Federal Travel Regulations, Part 301-11, Per Diem Allowances. Current per diem rates were effective October 1, 2002.

ACKNOWLEDGMENT:

Please acknowledge receipt of these instructions in your Monthly Report.

cc: N/NGS - D. Zilkoski*
N/NGS - J. Blackwell
N/NGS - S. Misenheimer*
N/NGS1 - G. Mitchell
N/NGS1 - K. Fancher
N/NGS1x1 - R. Zurfluh
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N/NGS22 - T. Soler
N/NGS3 - J. Bailey
N/NGS4 - E. Wade
N/NGS4 - M. Vorhauer
N/NGS6 - M. Chin
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